ILLINOIS POWER COMPANY

U-0175
L30-80(08-25)-0
500 SOUTH 27TH STREET, DECATUR, ILLINOIS 62525

August 25, 1980

Mr. Darrell G. Eisenhut
Director, Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Eisenhut:

Reference: NRC letter, dated April 21, 1980 from Steven A. Varga to All Construction Permit Operating License Applicants

Clinton Power Station Unit 1
Docket No. 50-461
Construction Permit No. CPPR-137
Category I Masonry Walls - Design Information Request

In response to the request for information on the use of Category I masonry walls, as outlined in the referenced letter of April 21, 1980, we are pleased to submit one copy each of the following for your use:

1. Response to NRC Information Request on Category I Concrete Masonry Walls - Dated August 22, 1980.

2. Design of Category I Concrete Masonry Walls - Sample Calculations - Dated August 22, 1980.

3. Drawings as listed in the Response to NRC Information Request

We trust that this information will adequately satisfy your request.

Sincerely,

G. E. Wuller

G. E. Wuller
Supervisor - Licensing
Nuclear Station Engineering Dept.

HBP/em

Attachment

cc: Mr. B. C. Buckley (w/o attachment)
NRC Clinton Project Manager

B001 s
1/1 SEND to: TERA (Return to REG Files after filming)

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Date <u>August 22, 1980</u>

CLINTON

RESPONSE TO NRC INFORMATON REQUEST
ON CATEGORY I CONCRETE MASONRY WALLS

Information Request No. 1:

Are there any concrete masonry walls being used in any of the Category I structures of your plant? If the answer is "No" to this question, there is no need to answer the following questions.

Response: Yes, Illinois Power Company is using concrete masonry walls in Category I structures for Clinton Station.

Information Request No. 2:

Indicate the loads and load combinations to which the walls were designed to resist. If load factors other than one (1) have been employed, please indicate their magnitudes.

Response: Masonry walls in Category I structures are being designed for loads and load combinations as given in the attached Table 1. These walls are not subjected to other design loads such as wind, tornado, missile, and pressure and jet impingement loads generated by a postulated pipe break.

Information Request No. 3:

In addition to complying with the applicable requirements of the SRP Sections 3.5, 3.7 and 3.8, is there any other code such as the "Uniform Building Code" or the "Building Code Requirements for Concrete Masonry Structures" (proposed by the American Concrete Institute) which was or is being used to guide the design of these walls? Please identify and discuss any exceptions or deviations from the SRP requirements or the aforementioned codes.

Response: Concrete masonry walls are being designed in accordance with the National Concrete Masonry Association "Specification for the Design and Construction of Load-Bearing Concrete Masonry," April 1974. No exception is being taken to this specification except that no overstress factor is being used for OBE load combination as against 1.33 recommended by the specification for such severe environmental loads as wind, earthquake, etc. For the abnormal/extreme environmental loading combinations involving SSE and LOCA loads, an overstress factor of 1.67 is being used. These overstress factors are consistent with the SRP guidelines for safety-related structures.

Information Request No. 4:

Indicate the method that you used to calculate the dynamic forces in masonry walls due to earthquake, i.e., whether it is a code's method such as "-iform Building Code, or a dynamic analysis. Identify the code and its effective date if the code's method has been used. Indicate the input motion if a dynamic analysis has been performed.

Response: Seismic lateral loads are being determined by an equivalent static method using the expression $w_s = gW$.
where:

w_s = seismic lateral load

W = weight of the masonry wall including any attachment load

g = seismic acceleration in the horizontal direction obtained from the combined floor response spectra curves. The combined curves being obtained by adding the spectra from seismic, SRV and LOCA events.

The natural frequency of the walls is being determined using standard expressions for single degree of freedom systems using the section properties of the wall based on the actual masonry unit size. The response spectra curves are entered with this calculated value of frequency to obtain the value of 'g'.

Walls are assumed as simply supported or cantilevered beams, as applicable, for frequency calculations and for design and analysis.

Information Request No. 5:

How were the masonry walls and the piping/equipment supports attached to them designed? Provide enough numerical examples including details of reinforcement and attachments to illustrate the methods and procedures used to analyze and design the walls and the anchors needed for supporting piping/equipment (as applicable).

Response: Masonry walls in Category I structures are being used as non-load bearing walls and are not being included as part of shear wall system for the Category I structures. These walls will only be relied upon as interior partition walls and will be separated from the floor above by a gap. .

No major piping or equipment will be attached to the Category I masonry walls. Attachments which will be allowed include small bore piping, instrument lines, conduits, junction boxes, etc. These attachments will be made either with expansion anchor or with through bolt plate assembly. Expansion anchors will not be used for hollow masonry walls.

Attachment loads are being accounted for in the design by assuming a concentrated mass at mid-span with a maximum eccentricity of 6 inches from face of the wall. Magnitude of the mass on any 1-foot wide horizontal strip of masonry wall is 180 lbs. for solid block walls, and 100 lbs. for hollow walls 12 inches thick or more. Actual attachment loads will be field verified and a final check will be made to ensure the adequacy of the walls.

Masonry walls are being designed using working stress principles with unfactored loads and are being analyzed based on conventional elastic methods. Design is being made using actual masonry unit size rather than the nominal. Horizontal reinforcement is ignored in the flexural design of the masonry walls.

Allowable stresses used for the design are given in attached Table 2. Whenever expansion anchors will be used for attachment of piping, there is a factor of safety of 4.0 for SSE. Effect of the anchor plate flexibility is taken into account for the design of expansion anchors.

Expansion anchors which will be allowed to be used are either wedge or sleeve type anchors with their sizes varying from 3/8" diameter to 3/4" diameter and with a minimum embedment length equal to 8 times the diameter.

Masonry walls in Category I structures are being constructed as single or multi-wythe hollow or solid block walls with full mortar bedding of the units using running bond construction. No cavity wall construction will be allowed. Properties of the different materials used for masonry wall construction are given in attached Table 3. Wythes will be bonded together by full mortar collar joints and by continuous truss bar reinforcement which overlaps the adjacent wythes every second course.

Sample calculations for concrete masonry walls in Category I structures for Clinton Station are attached.

Information Request No. 6:

Provide plan and elevation views of the plant structures showing the location of all masonry walls for your facility.

Response: The following is a list of drawings attached showing the plans of all the concrete masonry walls in Category I structures for Clinton Station:

Drawing No.	Rev.	Rev. Date	Drawing Title
W27-1000-00A	0	8-18-80	Containment Bldg. El. 712'-0" Aux. Bldg. El. 707'-6" & 712'-0" Fuel Bldg. El. 712'-0" Masonry Wall Index Sheet
W27-1001-00A	0	8-18-80	Containment Bldg. El. 737'-0" Aux. Bldg. El. 737'-0" Fuel Bldg. Unit 1 El. 737'-0" Masonry Wall Index Sheet
W27-1002-00A	0	8-18-80	Contain. Bldg. Unit 1 El. 755'-0" Aux. Bldg. Unit 1 El. 762'-0" Fuel Bldg. Unit 1 El. 755'-0" Masonry Wall Index Sheet
W27-1003-00A	0	8-18-80	Contain. Bldg. Unit 1 El. 778'-0" Aux. Bldg. Unit 1 El. 781'-0" Fuel Bldg. Unit 1 El. 781'-0" Masonry Wall Index Sheet

Drawing No.	Rev.	Rev. Date	Drawing Title
W30-1000-00A	1	8-18-80	Diesel Gen. HVAC and Control Bldg. Basement Floor El. 702'-0" & 712'-0" Masonry Wall Index Sheet
W30-1000-00C	1	8-18-80	Diesel Gen. and Control Bldg. Elevation 719'-0" Masonry Wall Index Sheet
W30-1001-00A	0	8-18-80	Diesel Generator and Control Bldg. Elevation 737'-0" Masonry Wall Index Sheet
W30-1002-00A	1	8-18-80	Diesel Generator and Control Bldg. Elevation 762'-0" Masonry Wall Index Sheet
W30-1003-00A	0	8-18-80	Diesel Generator and Control Bldg. Elevation 781'-0" Masonry Wall Index Sheet
W30-1004-00A	0	8-18-80	Diesel Generator and Control Bldg. El. 800'-0" & El. 825'-0" - 828'-3" Masonry Wall Index Sheet

In addition, the following is a list of typical design drawings attached showing the block wall details and plan views:

Drawing No.	Rev.	Rev. Date	Drawing Title
A21-1061	G	8 18-80	Typical Masonry Wall Details Sheet 1
A21-1063	H	8-18-80	Typical Masonry Wall Details Sheet 3
A21-1064	G	8-18-80	Typical Shielding Wall Details Sheet 1
A21-1065	P	8-18-80	Typical Shielding Wall Details
A21-1066	C	8-18-80	Typical Removable Shielding Wall Details Sheet 1
A21-1067	J	8-18-80	Typical Removable Shielding Wall Details Sheet 2
A28-1001-06A	J	8-18-80	Fuel Building Ground Floor Plan Area 6
A28-1001-07A	E	8-18-80	Fuel Building Ground Floor Plan Area 7
A26-1000-02A	M	8-18-80	Auxiliary Building Basement Plan Area 2

Drawing No.	Rev.	Rev. Date	Drawing Title
A26-1001-01A	J	8-18-80	Auxiliary Building Ground Floor Plan Area 1
A28-1000-02A	H	8-18-80	Fuel Building Basement Plan Area 2
A30-1001-01A	T	8-18-80	Control Building Ground Floor Plan Area 2
A30-1001-03A	S	8-18-80	Control Building Ground Floor PLan Area 3
A30-1003-02A	J	8-18-80	Control Bldg. Switchgear Floor Plan Area 2
A30-1004-06A	P	8-18-80	Control Building Main Floor Plan Area 6

TABLE 1

Load Combination Table For Category I Concrete Masonry

Load Category					SRV*			LOCA - Pool Dynamics*				Allowable Stresses
	D	L	E_o	E_{ss}	SRV_{ALL}	SRV_{1V2P}	SRV_{ADS}	PS	CH	CO	MVC	
Normal	1.0	1.0										Table 2
	1.0				1.0	1.0						
Severe Environmental	1.0		1.0		1.0	1.0						Table 2
Abnormal	1.0					1.0		1.0	1.0	1.0	1.0	1.67 X Table 2
	1.0						1.0		1.0	1.0		
Extreme Environmental	1.0			1.0	1.0	1.0						1.67 X Table 2
Abnormal/Severe Environmental	1.0		1.0			1.0		1.0	1.0	1.0	1.0	1.67 X Table 2
	1.0		1.0				1.0		1.0	1.0		
Abnormal/Extreme Environmental	1.0			1.0		1.0		1.0	1.0	1.0	1.0	1.67 X Table 2
	1.0			1.0			1.0		1.0	1.0		

*Only one load under each of these loadings shall be considered at one time.

Load symbols are defined as follows:

D = Dead load of masonry wall including attachment loads

L = Live load

E_o = Operating Basis Earthquake (OBE)

E_{ss} = Safe Shutdown Earthquake (SSE)

SRV_{1V2P} = Safety/Relief Valve (SRV) discharge loading due to discharge of one Safety/ Relief Valve subsequent actuation

SRV_{ADS} = SRV loading due to seven (ADS) Safety/Relief Valves discharge

SRV_{ALL} = SRV loading due to 16 (ALL) Safety/Relief Valve discharge

LOCA MVC = LOCA loading due to main vent clearing

LOCA PS = LOCA loading due to pool swell

LOCA CO = LOCA loading due to condensation oscillation

LOCA CH = LOCA loading due to chugging

TABLE 2

Allowable Stresses for Category I Non-Reinforced Concrete Masonry [d]

S No.	Description	Type of Unit [c]	Type of Mortar [c]	Symbol	Allowable Stresses (psi) Related to f'_m	Actual Value
1	Compressive					
	a) Flexure	Hollow or Solid	M	F_m	$0.3\ f'_m$	405 [a]
	b) Axial	Hollow or Solid	M	F_a	$0.2\ f'_m$	270 [a]
2	Shear	Hollow or Solid	M	v_m	--	34 [b]
3	Tension in Flexure					
	a) Normal to bed joints	Hollow	M	F_t	--	23 [b]
		Solid	M	F_t	--	39 [b]
	b) Parallel to bed joints	Hollow	M	F_t	--	46 [b]
		Solid	M	F_t	--	78 [b]
4	Bearing					
	a) on full area	Hollow or Solid	M	F_b	$0.25\ f'_m$	337 [b]
	b) on 1/3 area or less	Hollow or Solid	M	F_b	$0.375\ f'_m$	506 [b]
5	Modulus of elasticity			E_m	$1000\ f'_m$	1,350,000 (a)

NOTES:

(a) Actual values are based on f'_m = 1350 psi for Grade N-I hollow or solid masonry blocks.

(b) Applied to the net mortar bedded area.

(c) Material properties as per Table 3

(d) Table 2 is adopted from NCMA specification, April 1974.

TABLE 3

Concrete Masonry Material Properties

1)	Hollow Concrete Masonry Blocks:	ASTM C90, Grade N-I
2)	Solid Concrete Masonry Blocks:	ASTM C145, Grade N-I
3)	Mortar:	ASTM C270, Type M
4)	Reinforcement for Concrete Masonry:	Truss reinforcement, ASTM A82 with fy = 65 ksi

Date August 22, 1980

DESIGN OF CATEGORY I CONCRETE MASONRY WALLS SAMPLE CALCULATION

EXAMPLE I (12" Thick Hollow Block Wall)

I. DESIGN PARAMETERS:

Density = 105 lbs/ft^3; Type M mortar;
Modulus of Elasticity (E_m) = 1,350,000 psi. 2 Core-hollow block; Masonry wall lateral support column spacing see Fig. 1.
Masonry compressive strength $f'm$ = 1350 psi

II. ALLOWABLE STRESSES (Per NCMA; Inspected Workmanship)

Tension in Flexure (F_t)

Parallel to bed joints	=	46.0 psi
Perpendicular to bed joints	=	23.0 psi
Shear (V_m)	=	34.0 psi

III. WALL DESIGN (See Figure 1)

Assume the "g" value due to vertical excitation to be less than 1.0.

Assume the masonry wall not acting as a lateral support for another wall. (When masonry wall acts as a support, it is designed for in-plane shear.)

1. Span # 1 - Assume no attachments.

Assume 1-ft wide strip spanning vertically, L = 8'-0"

Section Properties:

W_W = 42.6 psf/ft
I = 1022.0 in^4/ft
S = 175.8 in^3/ft
A = 58.4 in^2/ft

Frequency Calculations:

$$f = \frac{56}{2\pi\sqrt{\frac{144 \times W_W \times L^4}{1350000 \times I}}}$$

Substituting the Values:

$$f = \frac{56}{2\pi\sqrt{\frac{144 \times 42.6 \times 8^4}{1350000 \times 1022.0}}} = 66.0 \text{ cps}$$

$$\text{Period } T = \frac{1}{f} = \frac{1}{66.0} = 0.0152$$

Wall Acceleration Values in Horizontal Direction

From the appropriate floor response spectra curves

g_{OBE} = 0.11

g_{SSE} = 0.24

g_{SSE} (Reduced) = 0.24/1.67 (Overstress factor = 1.67)
0.144 ← Governs

Stress Calculations: For 1-ft wide horizontal strip

Uniform load $W_S = 0.144\ (42.6) = 6.13$ lbs/ft

$$\text{Moment} = \frac{W_S\ L^2}{8} = \frac{6.13(8)^2}{8} = 49.0 \text{ ft-lbs}$$

$$\text{Shear} = W_S\ L/_2 = 6.13\text{x}8/2 = 24.5 \text{ lbs}$$

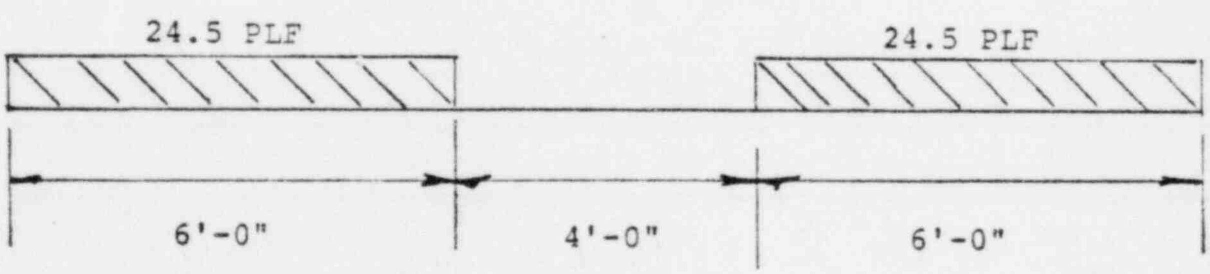
$$f_{t_s} = \frac{M}{S} = \frac{49(12)}{175.8} = 3.35 \text{ psi} < 23.0 \text{ psi (O.K.)}$$

$$v_s = V_s/A = 24.5/58.4 = 0.42 \text{ psi} < 34 \text{ psi (O.K.)}$$

Load Contribution on Span # 2 From Span # 1 (See Fig. 1)

Assume a 2'-0" wide beam band above the opening

$$R = \frac{W_S\ L \cdot}{2} = \frac{6.13(8)}{2} = 24.5 \text{ lbs.} \quad \text{(See Fig. 3)}$$



Additional Load on Span # 2 from Span # 1

FIGURE 3

Equivalent Uniform Load on 1-ft Wide Strip of Span # 2 Due to Load Contribution of Span # 1

Moment from additional load R $= \frac{2wa^2}{2} = \frac{2(24.5)(3^2)}{2}$

a = 6.0/2 $= 220.5$ ft-lbs.

Equivalent Uniform Load W $= \frac{8M}{L^2} = \frac{8(220.5)}{(16)^2} = 6.9$ PLF

2. Span # 2 - (See Fig. 1)

Assume 1-ft wide strip spanning horizontally L = 16'-0" (See Fig. 1)

Section Properties:
W_W = 42.6 psf/ft
I = 929.4 in^4/ft
S = 159.9 in^3/ft
A = 36.0 in^2/ft

Frequency Calculations:

$$f = \frac{56}{2\pi\sqrt{\frac{144 \times 42.6 \times 16^4}{1350000 \times 929.4}}} = 15.7 \text{ cps}$$

$$T = \frac{1}{15.7} = 0.0635$$

Wall Acceleration Values in Horizontal Direction

From the appropriate floor response spectra curves

g_{OBE} = 0.18

g_{SSE} (Reduced) = 0.60/1.67 = 0.36 ← Governs

Stress Calculations:

Uniform Load W_s = 0.36 (42.6) + Equiv. Uniform Ld. - Span # 1
= 15.3 + 6.9 = 22.2 lbs/ft.

Moment $= \frac{W_s L^2}{8} = \frac{22.2(16)^2}{8} = 710$ ft-lbs.

Shear $= W_s L/2 = 22.2 \times 16/2 = 178$ lbs.

$f_{t_s} = \frac{M}{S} = \frac{710(12)}{159.9} = 53.3$ psi $>$ 46.0 psi (N.G.)

$v_s = V_s/A = 178/36 = 4.9$ psi $<$ 34.0 psi (O.K.)

Reduce Span by Changing Support Column Spacing (See Fig. 2)

Reanalyze Span # 2 with reduced span length

- Span # 1 - Vertical Span - no change
- Additional Loading on 2 ft. wide beam band of Span # 2 From Span # 1 (See Fig. 4)
- $R = W_s L/2 = 6.13(8)/2 = 24.5$ lbs.

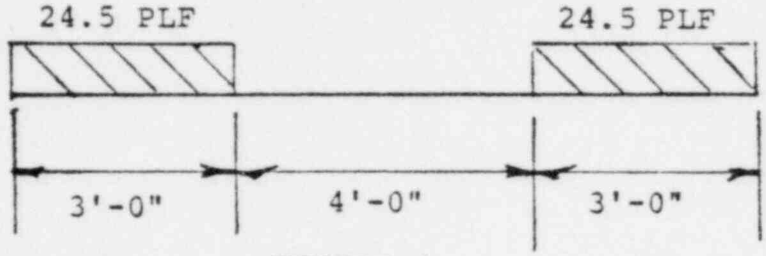


FIGURE 4

Equivalent Uniform Load on 1 ft. Wide Strip of Span # 2 Due to Load Contribution of Span # 1

Moment from Additional Load R = $\frac{2wa^2}{2} = \frac{2(24.5)(1.5^2)}{2}$

$a = 3.0/2$ = 55 ft-lbs.

Equivalent Uniform Load $W = \frac{8M}{L^2} = \frac{8(55)}{(10)^2} = 4.4$ lbs/ft.

- Span # 2 - Reduced span L = 10'-0" (See Fig. 2)

Frequency Calculations:

$$f = \frac{56}{2\pi \sqrt{\frac{144 \times 42.6 \times 10^4}{1350000 \times 929.4}}} = 40.3 \text{ cps}$$

$$T = \frac{1}{f} = \frac{1}{40.3} = 0.0248$$

Wall Acceleration Values in Horizontal Direction

From the appropriate floor response spectra curves

$g_{OBE} = 0.14$

g_{SSE} (reduced) $= 0.32/1.67 = 0.192$ ← Governs

Uniform Load W_s = 0.192 (42.6) + Equiv. Unif. Ld. - Span # 1
= 8.18 + 4.4 = 12.6 lbs./ft.

$$M = \frac{W_s L^2}{8} = \frac{12.6(10)^2}{8} = 157 \text{ ft-lbs.}$$

$$f_{t_s} = \frac{M}{S} = \frac{157(12)}{159.9} = 11.8 \text{ psi} < 46.0 \text{ psi (O.K.)}$$

By inspection actual shear stress is less than allowable.

3. Span # 3

Assume 1 ft. wide strip spanning horizontally, L = 10'-0"
(See Fig. 2)

Wall Frequency:

As calculated on Page 4

f = 40.3 cps

T = 0.0248

Wall Acceleration Values in Horizontal Direction

As calculated on Page 4

g_{OBE} = 0.14

g_{SSE} (Reduced) = 0.192 ←—— Governs

Uniform Load W_s = 0.192 (42.6) = 8.18 PLF

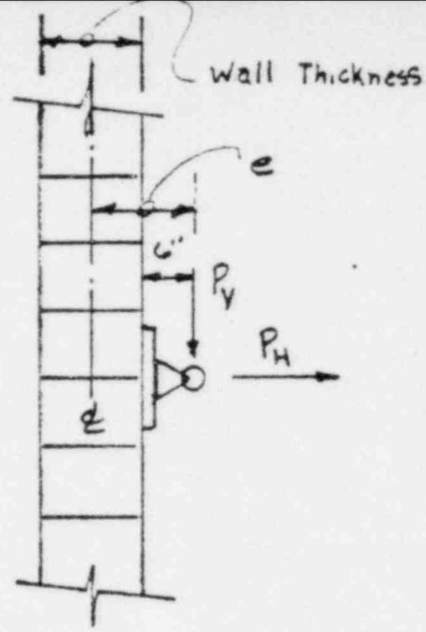
$$\text{Moment} = \frac{W_s L^2}{8} = \frac{8.18 \times 10^2}{8} = 102 \text{ ft-lbs}$$

$$f_{t_s} = \frac{M}{S} = \frac{102(12)}{159.9} = 7.6 \text{ psi} < 46.0 \text{ psi (O.K.)}$$

By Inspection actual shear stress is less than allowable

Add effect of attachment load to the tensile stress
f_{t_s} = 7.6 psi. For calculations see Page 6

IV. DESIGN FOR ATTACHMENT LOADS



Assume 1 - ft. wide horizontal strip. Maximum assumed attachment load "P" for 12" hollow block wall at an eccentricity of 6" from face of the wall = 135 lbs.

There are three loads due to Load P

1. Horizontal load $P_H = g_H P$
2. Vertical load $P_V = (1+g_V)\ P$
3. Eccentric Moment = P_V x e

Different mortar surfaces, horizontal as well as vertical, at the location of attachment, have enough shearing resistance to resist the block-pulling effect from the loads mentioned above. The overall bending effect of load P_H is considered assuming a 1 - foot horizontal strip acting as a beam between the supports. The attachment load is considered either as one concentrated load at mid-span or two concentrated loads, one at each quarter point of the span. Tensile stresses due to this bending are directly added to the tensile stresses f_{t_s} calculated on Page 5.

Moment 'M' due to P_H = $P_H L/4$ ft-lbs.

where

$L = 10'\text{-}0"$

$P_H = g_H P = 0.192 \times 135 = 25.92$ lbs.

(g_H = 0.192 calculated earlier on Page 5)

$M = P_H L/4 = \frac{25.92 \times 10}{4} = 64.8$ ft-lbs.

$S = 159.9\ in^3$

f_{t_a} = tension due to attachment load

$= \frac{64.8 \times 12}{159.9} = 4.9$ psi

f_{t_s} due to wall seismic load = 7.6 psi (calculated on Page 5)

Total tensile stress, $f_t = f_{t_s} + f_{t_a}$

$= 7.6 + 4.9 = 12.5$ psi $<$ 46.0 psi (O.K.)

V. MASONRY WALL SUPPORT COLUMN DESIGN

Uniform Load on Column:

For loading on the column assume two concentrated attachment loads, one at each quarter point of the span.

$W = bW_s + 2(135\# \text{ attach.})\ g_{SSE}$ (reduced)

$= 10 \text{x} 8.18 \text{ PLF} + 2\ (135) 0.192 \text{ PLF}$

$= 81.8 + 51.3 = 133.6 \text{ PLF}$

$$M = \frac{W\ L^2}{8} = \frac{133.6(20.0^2)}{8} = 6700.0 \text{ ft-lbs.} = 6.7 \text{ ft-kips}$$

Allowable $F_b = 0.66$ Fy for g_{OBE} (column fully embedded in masonry)

since 1.67 (.66 Fy) exceeds 0.95 Fy;

$$F_b = \frac{0.95\ Fy}{1.67} = 0.57\ Fy \text{ for reduced } g_{SSE}$$

$$S_{req'd} = \frac{M}{F_b} = \frac{6.7 \text{x} 12}{0.57 \text{x} 36.0} \quad (Fy = 36 \text{ ksi})$$

$= 3.92 \text{ in}^3$

Use Minimum Size W8x18 (S = 15.2 in^3) for Steel Column as Masonry Wall Support.

EXAMPLE II (36" Thick Solid Block Concrete Masonry Wall)

I. DESIGN PARAMETERS:

Non-load bearing masonry wall

Density = 140 lbs/ft^3

Type M mortar; Masonry compressive strength f'_m = 1350 psi

Modulus of elasticity (E_m) = 1,350,000 psi

II. ALLOWABLE STRESSES (As per NCMA, Inspected Workmanship)

Tension in flexure (F_t)

Parallel to the bed joints	= 78.0 psi
Perpendicular to bed joints	= 39.0 psi
Shear (V_m)	= 34.0 psi

III. WALL DESIGN

36" thick solid block wall is multi-wythe construction bonded together by full mortar collar joint and by continuous truss bar reinforcement which overlaps the adjacent wythes every second course. As such, the section properties of 36" thick solid block wall are used for design. The design procedure is essentially the same as shown for 12" hollow block wall in Example No. 1 except for the section properties of 36" solid block wall which are as follows:

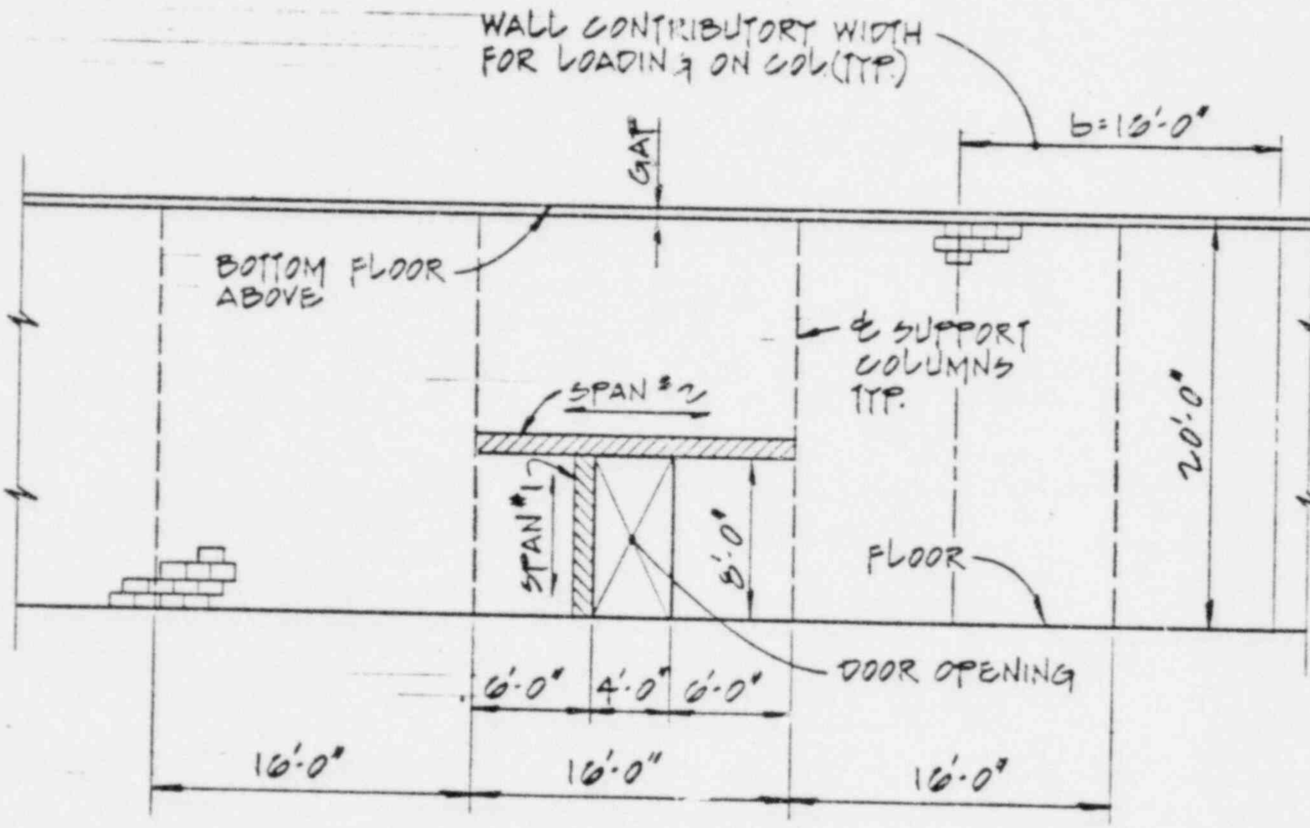
$A = 427.5\ in^2/ft$

$I = 45213.0\ in^4/ft$

$S = 2538.3\ in^3/ft$

wall weight W_W = 430.5 PSF of wall area for $140\#/ft^3$ solid block wall

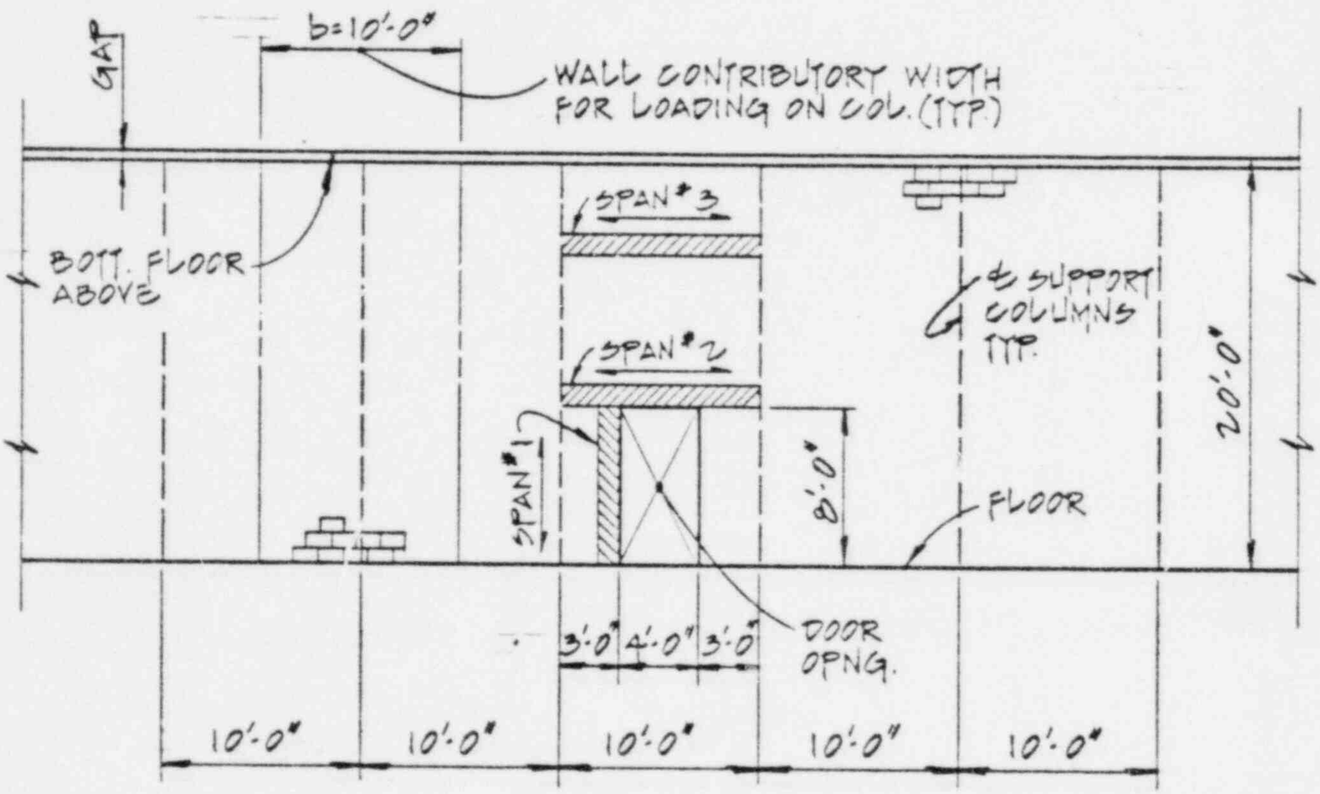
Frequency calculations are based on the section properties of 36" solid concrete block wall.



MASONRY WALL ELEVATION

FIGURE 1

MIKE YONAN



MASONRY WALL ELEVATION

FIGURE 2

MIKE YONAN